DATA TECH

OUR COMPANY

Since 1960, DATA TECHnology, Inc. has provided commercial and industrial markets with cost-effective products demonstrating the latest state-of-the-art technology. Offering a diverse product line in both the area of systems as well as control instrumentation, DATA TECHnology maintains solid product support services, parts availability, and accessibility to technical consultation throughout the world!

DATA TECHnology, Inc.

ASSISTED LINE DIGITIZING SYSTEM

1. Introduction.

The DATA TECHNOLOGY Assisted Line Digitizing system represents an innovative concept in transforming graphical data into digital form. The system combines the beneficial features of scanning digitizers with the advantages of manual digitizers. This combination results in the ability to digitize large amounts of graphical data without any major need for sorting out erroneous data. The operator is always in command of what data is being recorded and in what order the data is being digitized. These features that allow the digitizing of data more quickly with fewer errors and less operator fatigue results in a more cost effective system.

2. General Description.

The DATA TECHNOLOGY Assisted Line Digitizing System takes away from the operator the tedious and time consuming effort of digitizing lines point by point while leaving to him all the logical decisions occurring at node points and where the manuscript is ambiguous or faulty. The system increases very substantially the operator's constant productivity while the operator's constant supervision assures an output free of interpretive errors, minimizing the need for later editing and correcting of the record. The operator freely manoeuvres a servo-powered digitizing head across the prepared manuscript by means of a small joystick. Then, when over the line he has selected for digitizing, the operator turns on a variable lock control and the head locks onto the line. The operator now only needs to push the head casually along the line while points are digitized automatically at a fast rate, according to a pre-established digitizing routine (up to 100 points per second). At any time, and in particular at nodes and branch points, the operator adds points of his choice which are incorporated within the automatically recorded data. These points, called ANCHOR POINTS, are

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automatically marked by a red circle on the manuscript and can be referred to graphically at any later time during the digitizing process.

The ANCHOR POINTS are the access points provided for the operator to the graphic structure being digitized. New lines can be started from previously defined anchor points or be connected to such anchor points by suitable commands. Anchors can also represent isolated points and be labeled or erased for correction purposes.

The operator has complete freedom to define ANCHOR POINTS as long as the two following conditions are satisfied:

* Any point along a line which might be referred to at a later time must be inserted as an ANCHOR POINT the first time around. (Otherwise, erasing of line and redigitizing will be required later.)
* When two (2) different connecting lines are to be digitized between two (2) given anchor points, an additional anchor point must be inserted in one of the paths at least, to eliminate the path ambiguity which would otherwise result. (As a safety, the system warns the operator if he fails to do so.)

If the lock fails and erroneous data results, the operator can, at any time, cancel by a single command all points taken since the last ANCHOR POINT. He can then return to this last ANCHOR POINT and resume digitizing. In addition, the operator has, at any time, the capability to return to previously digitized data for editing and correcting. (See Cancellation Commands section 6.4.)

3. The Digitizing Head.

The heart of the servo-powered head is a bright light spot produced by a Helium-Neon laser. This spot has two functions:

* To the operator, it provides an indication of the position of the head on the manuscript (as a crosshair would). For this purpose, the spot brightness, as seen by the operator, is controlled by a variable optical filter.
* To the system, the spot provides a signal which is used to generate an automatic lock onto the line being digitized. For this purpose the spot size can

be selected by the operator to match the width and quality of the line being digitized. This is achieved by inserting various beam modifying lenses in the path of the laser beam. (Note that since detector and operator are always observing the same spot, there is no parallax problem.)

The digitizing head is at all times under dual control:

* by the operator through the servo-powered joystick;
* by the tracking system through the signal generated;
* by the line illuminated by the spot.

The intensity of the tracking signal relative to that of the joystick is adjusted by the operator according to his needs by means of the variable lock control provided on his hand control.

To help the operator in his control of the head, dynamic characteristics of the head, such as inertia, are controlled electronically and can be set to suit both the operator's preference and the nature of the lines being followed. These dynamic controls can also be used to achieve specific kinds of analog processing at the time of digitizing, such as line smoothing or reestablishing continuity in a dashed line.

An auxiliary crosshair may be attached to the head to digitize isolated points without using the laser spot.

4. Operator Controls.

While controlling the digitizing with one hand, the operator conveys all his commands with the other by means of keys on a small hand control resting on the table in the vicinity of the head.

In addition to the command keys, the hand control includes the variable lock control, the controls for dynamic response of the head, two (2) status lights, and a small alpha-numeric display which flashes messages and pertinent information on the digitizing in progress.

The command keys are listed elsewhere, together with their exact functions.

Program initiation, including setting up of initial parameters such as scaling and orientation, is achieved through a separate alpha-numeric CRT, which is also used to enter alpha-numeric text for labels.

5. Data Structure.

The system recognizes three kinds of entities, stored in three distinct lists: anchors, segments, polygons.

5.1. ANCHORS are single points always specified by the operator. Anchors are numbered chronologically. When an anchor is defined, its position is marked by a red circle on the manuscript. Previously defined anchors can be referred to later on the manuscript by bringing the digitizing head close to the (circled) anchor desired; upon a command (Refer Key), the system identifies the anchor which lies closest to the head. At any time, the CURRENT ANCHOR is the latest anchor, either defined or referred to by the operator. Its identification number is always on display.

Any anchor can have associated with it:

* a code or symbol (Anchor Code Keys);
* a positioning off-set which permits the operator to specify the placement of a symbol or label relative to the anchor positions (Label Key);
* an orientation vector which permits the operator to specify the orientation of the symbol or label relative to manuscript features (Anchor Code 00).

5.2. SEGMENTS are sequences of consecutive points digitized automatically, according to a pre-established procedure, as the digitizing head moves along. They represent the path traveled by the head. Segments are numbered chronologically and have associated with them the segment code effective at the time.

Segment extremities are always anchors and no intermediate anchor can exist along a segment.

Segments are always originated at the CURRENT ANCHOR, effective when the Segment-Start Key is depressed, and is terminated automatically

at the new CURRENT ANCHOR when the CURRENT ANCHOR is changed by either an anchor-define or an anchor-refer command.

Any segment must be unambiguously identified by its two end-anchors.

Segments are, in general, curvilinear (C-segments), but can also be rectilinear segments (R-segments) defined as the straight line between two end anchors.

5.3. POLYGONS are defined as any ordered sequence of anchor points. Polygons are numbered chronologically and have associated with them the polygon code effective at that time.

A polygon is recorded as the succession of CURRENT ANCHORS, from the CURRENT ANCHOR effective when the Polygon-Start Key is depressed to the CURRENT ANCHOR effective when the Polygon-End Key is depressed. A polygon is closed when the starting anchor and the ending anchor coincide; otherwise it is open.

A polygon may be defined as comprising all the curvilinear or rectilinear segments joining its successive anchors (curvilinear polygon; C-polygon) or as being constructed with straight lines joining its successive anchors (rectilinear polygon; R-polygon). An R-polygon needs only anchors to be definable. In addition to its code, a polygon can have an individual label specified and positioned by the operator (Anchor code 99).

5.4. The complete topological structure of the network is stored in the anchor-list by cross-references to the segments attached to each anchor point.

All the detailed line data is stored in the segment list which needs to be accessed only when a specific path has to be followed between two anchors.

All polygons are described in the polygon list.

The description of a polygon consists simply in the list of the anchor points involved.

6. Commands.

There are fifteen (15) function keys, ten (10) coding keys allowing for one hundred (100) different codes to be assigned to any

anchor unlimited label codes, and five (5) cancellation keys used to correct errors and modify the digitized manuscript.

The fifteen (15) function keys are grouped in three (3) categories of five (5) each, relating to anchors, segments, and polygons respectively. (See sketch in Operator's Controls section.)

6.1. Anchor-Related Commands.

6.1.0. Define.

Always:

* defines new anchor at present head position
* increments anchor counter and assigns value to new anchor
* records new anchor coordinates in anchor-list under anchor number as "no code" anchor
* establishes new anchor as CURRENT ANCHOR and displays anchor number as CURRENT ANCHOR
* prints circle at corresponding spot on manuscript.

If segment in progress:

* terminates automatic digitizing sequence
* turns off segment-in-progress light
* increments segment counter
* assigns -segment # to last CURRENT ANCHOR and +segment # to new CURRENT ANCHOR
* adds new CURRENT ANCHOR coordinates to segment buffer and transfers segment buffer to segment list under segment # coded with current segment code.

If polygon in progress:

* add new CURRENT ANCHOR to polygon in progress subject, in case of C-polygon, to segment existing between last and new CURRENT ANCHOR; if not,

  Message: NO SEGMENT + BUZZ

* compare new anchor to first anchor in polygon buffer; if same,

  Message: POLYGON CLOSED + BUZZ.

6.1.1. Refer.

Always:

* finds in anchor-list anchor closest to present head position (with a maximum limit set by program)
* establishes that anchor as CURRENT ANCHOR and displays anchor number and code.

If segment in progress:

* same as for DEFINE command.

If polygon in progress:

* same as for DEFINE command.

6.1.2. Label.

Always:

* defines present head position as positional offset assigned to current anchor for label positioning or other purpose
* transfers control to code keys for coded label of arbitrary length terminated by 0; if code is 0 only, control is transferred further to keyboard for full text.

6.1.3. Test.

Always:

* finds in anchor-list anchor closest to present head position

  Message: TEST ANCHOR = #.

6.1.4. Parallax.

Always:

* adds pre-established parallax to any coordinate readings resulting from the immediately following command
* parallax automatically deactivated at end of that command.

6.1.5. Anchor Codes.

6.1.5.0.

* Sequence of two (2) code digits duplicates exactly all functions of DEFINE command and, in addition, assigns the particular code to the anchor generated.

6.1.5.1. Code 00.

* does not define a new anchor with code 00, but instead assigns a vector orientation to the CURRENT ANCHOR, in addition to codes or labels it may already have;

  the direction assigned is the direction defined by the head position at the time relative to the CURRENT ANCHOR.

6.1.5.2. Code 99.

* if keyed immediately after Polygon End command, that anchor will be cross-referenced to the just completed polygon as a means to label it according to operator's desires.

6.2 Segment Related Commands.

6.2.0. C-Start.

Always:

* clears segment buffer
* enters CURRENT ANCHOR coordinate in segment buffer
* initiates automatic digitizing sequence and enters digitized points in segment buffer
* turns on segment-in-progress light and status
* displays segment counter +1 and code letter C
* keeps track of number of points accumulated and eventually gives message

  Message: BUFFER NEAR FULL + BUZZ.

6.2.1. R-Start.

Always:

* clears segment buffer
* enters CURRENT ANCHOR corrdinate in segment buffer
* turns on segment-in-progress light and status
* displays segment counter +1 on display and code letter R.

6.2.2. Abort.

Always:

* terminates automatic digitizing sequence
* stops segment counter display
* turns off segment-in-progress light and ends status
* clears segment buffer.

6.2.3. Resolution.

Always:

* cancels segment labeling code valid at the time and accepts new digit code from coding keys
* updates display.

6.2.4. Code.

* cancels segment labeling code valid at the time and accepts new digit code from coding keys.

6.3. Polygon Related Commands.

6.3.0. C-Start.

Always:

* displays (polygon counter +1) with code letter C on display
* turns on polygon-in-progress light and status
* clears polygon buffer
* enters CURRENT ANCHOR and code letter C in polygon buffer.

6.3.1. R-Start.

Always:

* displays (polygon counter +1) with code letter R on display
* turns on polygon-in-progress light and status
* clears polygon buffer
* enters CURRENT ANCHOR and code letter R in polygon buffer.

6.3.2. End.

Always:

* compares CURRENT ANCHOR with first anchor in polygon buffer

  Message: POLYGON CLOSED

If same:

* increments polygon counter
* transfers polygon number, labeling code, and full content of polygon buffer in polygon list
* turns off polygon-in-progress light end display of starting ANCHOR.

If different:

* upon repeat of END command, polygon is ended

  Message: POLYGON OPEN-CONFIRM

* if END command not repeated, the previous END command is ignored.

6.3.3. Abort.

Always:

* turns off polygon-in-progress light and status
* ends display of starting anchor
* clears polygon buffer.

6.3.4. Code.

Always:

* cancels polygon labeling code valid at the time and accepts new code from code keys
* updates polygon code on display.

6.4 Cancellation Commands.

6.4.0. Polygon.

Always:

* command followed by full polygon defining procedure will delete this polygon if it exists

  Message: NO SUCH POLYGON or POLYGON NUMBER DELETED.

6.4.1. Segment.

No C-polygon involved:

* command followed by full segment defining procedure will delete this segment if it exists

  Message: SEGMENT NUMBER DELETED or NO SUCH SEGMENT.

C-polygon involved:

Message: POLYGON ## INVOLVED: CONFIRM

* repeat of cancellation command will cancel despite polygon involved

  Message: SEGMENT # DELETED-POLYGONS INVALID.

6.4.2. Anchor.

No segment involved:

* if no R-polygon involved: deletes CURRENT ANCHOR and associated labeling

  Message: ANCHOR # DELETED

* if R-polygon involved

  Message: R-POLYGON INVOLVED, CONFIRM

* repeat of cancel command will delete anchor despite polygon

  Message: ANCHOR # DELETED R-POLYGON INVALID.

Segment involved:

  Message: SEGMENT # INVOLVED CONFIRM

* repeat of cancel command will delete despite segments

  Message: ANCHOR # DELETED SEGMENTS INVALID.

6.4.3. Label.

* command followed by anchor-defined command will substitute no code for old code on CURRENT ANCHOR
* command followed by anchor-code command will substitute new code for old code on CURRENT ANCHOR
* command followed by anchor-label and labeling routine will substitute new code for old code on CURRENT ANCHOR.

6.4.4. Parallax.

* cancel anchor-parallax command.

Hardware and Specifications.

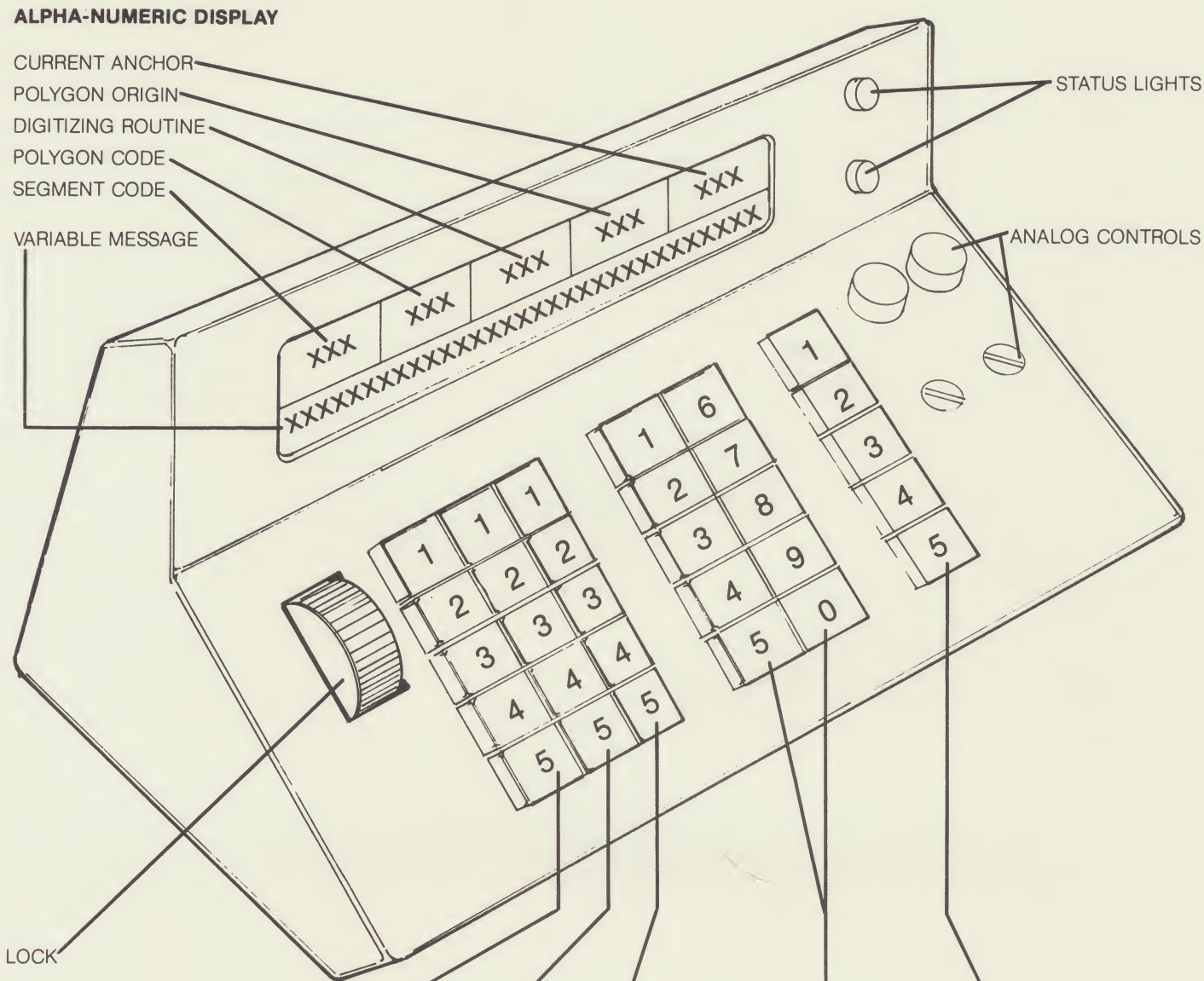
The complete system consists of a tiltable table (usually 34" x 60") equipped with a servo-powered digitizing head and a table-top hand control. It includes a separate alpha-numeric CRT used to initiate the program, set up scaling and orientation and enter textual information, a micro-computer (LSI 11, 32K RAM) to implement the program, and a disk (hard disk) for data storage.

Digitizer electronics, computer and disk are located in the cabinet which constitutes the base of the table.

As an option, a plotting arm can be added to the table mounted on the same rail carrying the digitizing arm.

Table accuracy:	.004" between any two (2) points.
Table resolution:	.001".
Line tracing fidelity:	depends on operator skill, speed of tracing and selection of dynamic characteristics of head, as well as quality of manuscript usually of the order of one (1) line width on manuscript.
Acceptable manuscripts:	dark lines, preferably black and blue (no red) on light background; non-glossy finish.
Point acquisition rates:	over 100 points per second in stream mode.
Segment buffer size:	points (= maximum number of points in a segment between two (2) consecutive anchor points).
Disk storage capacity:	over one million (1,000,000) digitized points over ten thousand (10,000) anchor points.
Coordinate recording:	all absolute, 16 bit x 16 bit y.

ALD HAND CONTROL



ANCHOR RELATED COMMANDS

1. DEFINE
2. REFER
3. LABEL
4. TEST
5. PARALLAX

SEGMENT RELATED COMMANDS

1. C-START
2. R-START
3. ABORT
4. RESOLUTION
5. CODE

POLYGON RELATED COMMANDS

1. C-START
2. R-START
3. ABORT
4. END
5. CODE

CODE KEYS

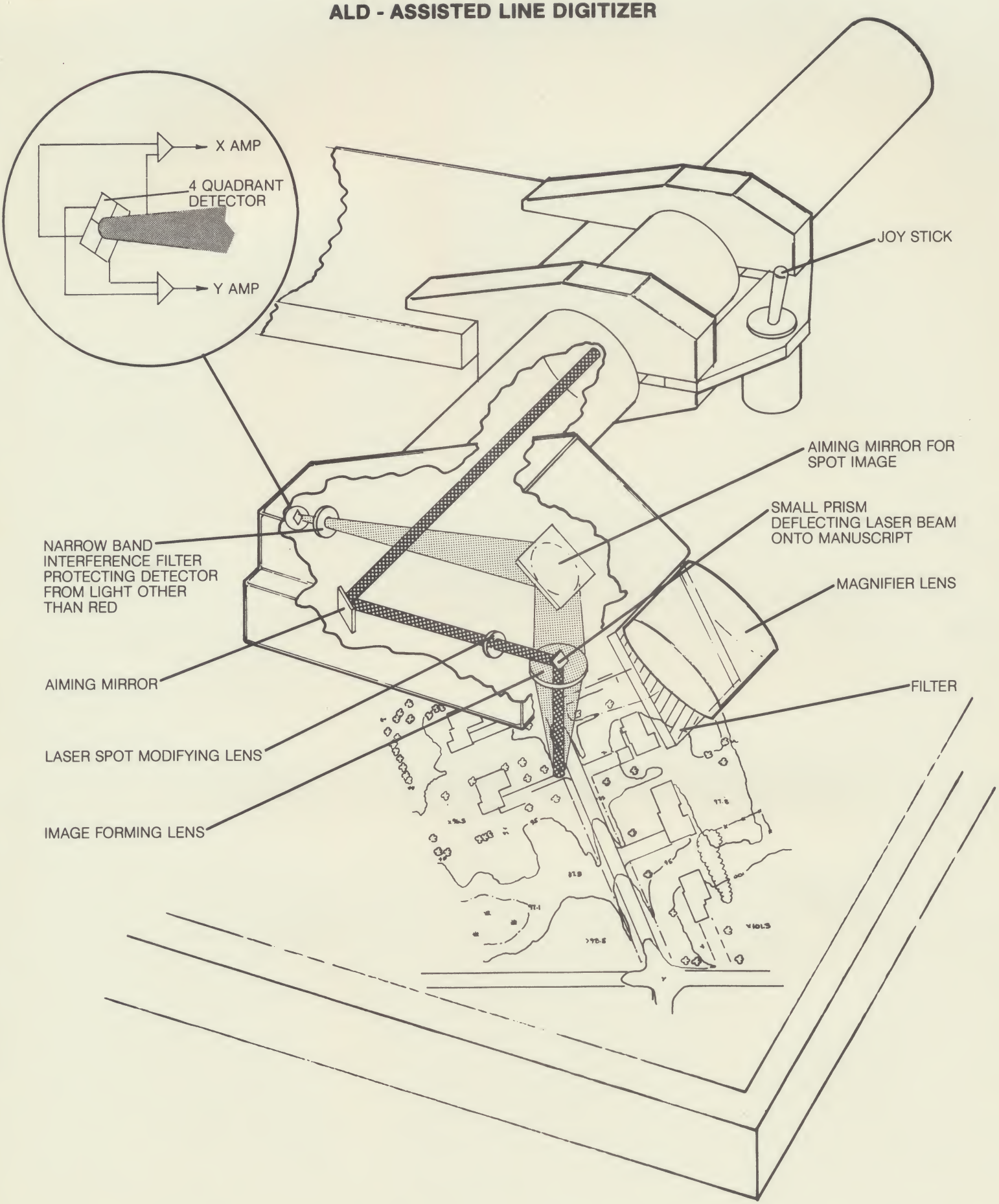
2 DIGITS

EXCEPTIONS
00
99

CANCELLATION COMMANDS

1. ANCHOR
2. SEGMENT
3. POLYGON
4. LABEL
5. PARALLAX

ALD - ASSISTED LINE DIGITIZER



CDA
INTERACTIVE GRAPHICS SYSTEMS

GENERAL DESCRIPTION

The CDA (Computer Drafting Aid) systems are the result of DATA TECHnology, Inc. extensive experience in the computer graphics field. They have been designed to meet a draftsmans needs in a wide number of applications ranging from mechanical, electrical and civil engineering to cartography and hydrography.

The systems use a digitizer or tablet for the input of graphic data whic can be instantaneously viewed on a visual display screen. This enables the draftsman to immediately verify the input data and gives him the opportunity to make any necessary corrections. As the data is input, it is stored on disk for fast retrieval and manipulation before being output to magnetic tape, a plotter or a main frame computer.

The systems, which are completely free-standing in operation, contain a processor, hard disk, graphic display unit, magnetic tape read/write unit, keyboard and a digitizer or tablet. The processor used in the basic system is a PDP11 Series with 28 K of main memory.

No special operating knowledge is required as a simple, unambiguous menu combined with prompts from an alphanumeric display provide the operator with step-by-step instructions. The software permits the rapid construction of data files which can readily be verified, manipulated and edited. It is written mainly in Fortran, so there are Fortran calls to all the graphic routines to allow the user to easily write his own applications programs. Basic software common to all systems provides the user with the ability to:

- Create graphic files up to 64 levels.
- Make any one of those files, or levels within the file, a macro for repeated placement.
- Merge files, or levels of files, to create new graphics.
- Apply scaling, rotation or mirror imaging transformations to complete files or file levels.
- Find points, lines or arcs within a file and edit or transform as required.
- Output files to any one or more of the peripheral units.

DATA TECHnology, Inc. has support and service organizations throughout U.S.A., Canada and Europe which enable it to provide customers with fast, on-site assistance as and when required. It is the policy of the company through this network to provide close customer support for both hardware and software.

GENERAL PURPOSE SYSTEMS

The basic CDA is a single seat, on-line general purpose drafting system. Major features of the system are its simplicity of operation and extremely flexible filing system and the ease with which application programs can be incorporated, either by the user or by DATA TECHnology, Inc.

The system combines a digitizer, a computer with hard disk drive and a large screen visual display in an interactive configuration which allows the user to input data by digitizing and see immediately, in graphic form, the effect of each action. This, together with the ease with which data files can be created, saved, transformed and merged with other files for trial layouts on the display, makes the system particularly suitable for graphic design applications.

All system operation, control and mode selection commands are generated by digitizing a standard menu and prompt messages are displayed for guidance. With this technique, there is no need for the operator to learn and memorize a complicated command language and the system can easily be used by experienced and occasional user alike.

The system can be used to drive almost any plotter in a background mode, leaving the digitizer and visual display free for further work.

GRAPHIC DESCRIPTION FACILITIES

- Straight lines, arcs, semi-circles and rectangles defined by points input in coordinate or polar form relative to fixed datum or any other point
- Straight line, arc or cubic spline interpolation with stream digitizing for high point density.
- Recall of previously input points, lines and arcs as reference for precise positioning of associated data.
- Software cursor locks for horizontal, vertical, angled or gridded input relative to be fixed datum or to any other point
- Parallel lines, hatching, fillets and dimensioning with automatic generation of leader lines and arrowheads
- Horizontal, vertical or angled text at any size.
- Scaling, rotation and mirror imaging transformations.

A multi-seat version of the CDA system can contain a number of independent graphics input workstations, each with its own digitizer and visual display.

SYSTEM HARDWARE COMPONENTS

The system hardware consists essentially of a workstation and a central processor.
The workstation, in turn, consists of a digitizer, a vector video display, an alphanumeric keyboard and an alphanumeric display and DT3454 Automatic Drafting Plotter. The workstation is the center of all data input, verification, editing and output operations.
The central processor controlling the system is one of the DEC PDP11 family of minicomputers This computer was chosen both for its suitability as the central processor in the CDA systems and because of the acceptance and support it receives as the most widely used minicomputer today.

SYSTEM FACILITIES

Digitizing
The first step in all data processing is to provide the computer with the basic data. Where the source of this data is graphics, drawing, sketches, photographs, etc., it must first be converted into digitial form for input to the computer before it can be processed. The digital input information defining the graphic information is a mixture of coordinate values and alphanumeric coding or qualifying information. There will also be system control data. In the CDA system, virtually all data is generated by digitizing.

Disk Storage
The standard single station system is equipped with a 5 megabyte removable cartridge disk system. The disk unit is housed in the central processor cabinet on pull-out rails and the cartridges are top loading.

System Files
In order to function correctly, the CDA system generates and maintains its own system files.

Data Files
The data filing system is effectively a user data base residing totally on the exchangeable cartridge disk. The system utilizes explicitly named or concisely numbered files. A file as such has no predetermined size and adjusts automatically to the amount of data entered into it up to the total capability of the filing system.

Levels
Each of the file data units can also have up to 64 levels allocated to it, each of which can be considered as a tag which enables a file to be split into 64 identifiable sections.

Display Files

Display is normally from the workspace via a level filter controlled by three menu commands, 'Set All Levels', 'Reset Levels' and 'Display Workspace Levels'. With the command 'Set All Levels' present all data in the workspace is displayed. When 'Reset Levels' is present, the filter will allow only those levels nominated by the operator to pass. In this way, selected parts of a file present in the workspace may be displayed separately.

Macro Files

A Macro is a discrete set of data that can be operated on as a unit. In the CDA system, this can be any file or set of data residing in the filing structure of the system. Since a file can be any size, a macro can be as large as required, just a few lines or even a single line or symbol. Macro files can also be nested within other larger macro files.

GRAPHIC DESCRIPTION FACILITIES

Graphic detail is defined in terms of graphic elements. The size and location of the elements is defined by coordinate values. The type of element is defined by mode commands input by probing a menu. Mode commands, once defined, remain in force until a new mode is selected.

Basic Drawing Set Up Commands

- Drawing origin
- Skew
- Set menu position
- Input scale

Digitizing Mode Commands

- Digitize
- Break line/new line
- Find point
- Stream digitize
- Line Length
- Line type
- Pen type
- Window

Cursor Mode Commands

- Cursor lock
- 90° lock
- Angle lock
- Absolute angle lock
- Grid lock
- Grid intersect

Constructed Element Commands

- Rectangle
- Circle
- Semi-circle
- 3 point arc
- Line/line fillet
- Cross hatch

Interpolated Curve Commands

- Arc fit
- Spline fit

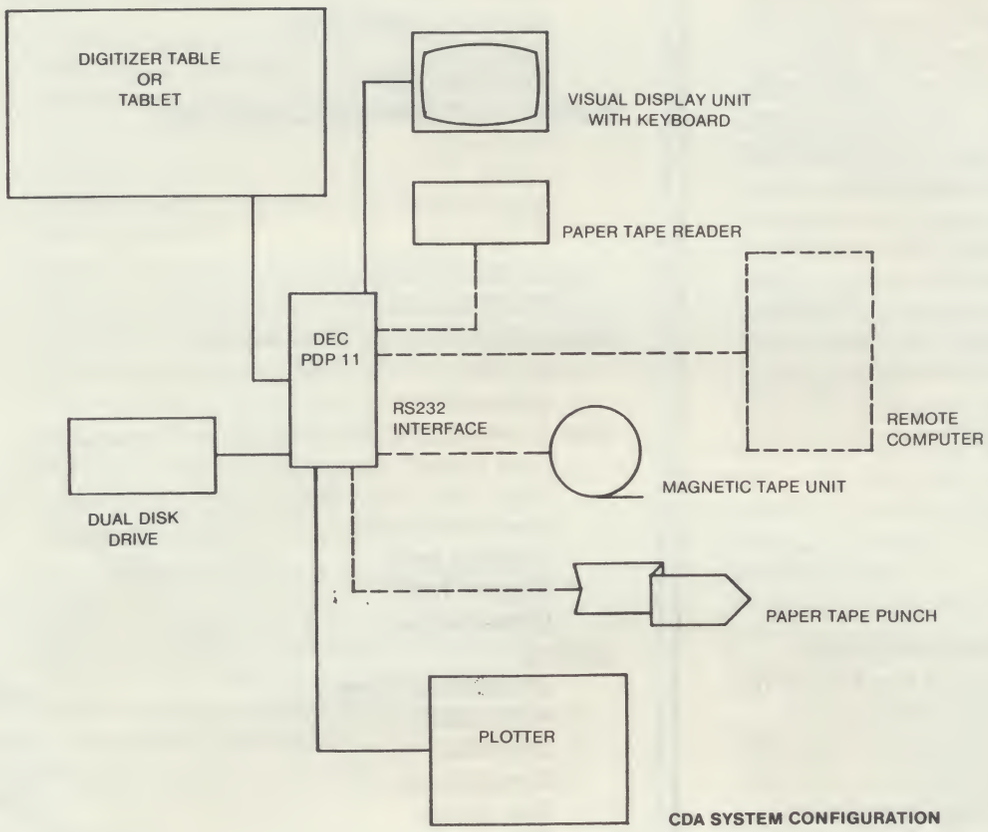
Text Commands

- Text height
- Text ratio and slant
- Horizontal text
- Vertical text
- Angled text
- Dimensions

Editing

- Delete last item
- Point edit
- Line edit
- Symbol edit
- Box erase
- Macro edit

CDA



CDA SYSTEM CONFIGURATION

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3454 Plotter